UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
~~SOIL AND WATER CONSERVATION RESEARCH DIVISION~~
~~RIO GRANDE SOIL AND WATER RESEARCH CENTER~~
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December 1, 1972

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RE: Type I Report, period June 19 to Oct. 19, 1972; Task 3 (431-641-14-01-07), ERTS Contract No. S-70251-AG; Goddard ID: AG 339.

Gentlemen:

A Type I report for the referenced task, contract, investigation, and time period is attached in fulfillment of contract provisions.

We feel we are in a good state of readiness to make significant analyses as soon as CCT's are received.

Sincerely,

Craig Wiegand

Craig L. Wiegand, P.I., AG 339
(Reflectance of Vegetation, Soil, and Water)

cc:
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Pat George (ltr only)

This report is submitted for ERTS Contract No. S-70251-AG for the period June 19, 1972 through October 19, 1972.

Title of Investigation: Reflectance of Vegetation, Soil, and Water

GSFC ID: AG 339

Statement of Problems in the Report Period: The first problem encountered was a personnel ceiling, more particularly learning that the in-house personnel ceiling on temporary employees would have to be adhered to in spite of the fact that contract (or non in-house) funds had been obtained. Internal personnel shifts were made to make the four needed positions available. After 4 months of intense effort under Civil Service procedures the positions were filled by two full-time agricultural research technicians, one full-time computer programmer, and an intermittently-employed computer programmer.

The second problem that has been encountered is that the passage of the satellite and our cloud-free days have not coincided. Thus no digital magnetic tapes have been retrospectively ordered. Digital magnetic tapes from the aircraft support (Mission 207, flown 6/26/72) have not been received either, although they are expected in the near future.

A third problem encountered is that the aircraft data will be formatted differently than the ERTS-1 tapes from GSFC and that it will take more core than our IBM 1800 System offers to extract the data for each of the 11 channels of data requested. This formatting problem will hopefully be resolved during the next reporting period.

Statement of Accomplishments in Report Period:

1. Digital Data Display. Prior to the contract period, it was realized that some means of displaying the CCT of ERTS data would be necessary in order for humans to interact with them to edit them, select training sites, etc. A DICOMED Model 36 Display was obtained from in-house funds and installed. A system of Digital Image Display Subroutines (SODIDS) has been developed during this reporting period and is operational. The subroutines provide a tool for interaction among user, digital image display, and computer. Their use and function have been described.[1]

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[1] R. J. Torline. System of Digital Image Display Subroutines (SODIDS). 22 p. plus appendices. August, 1972. USDA Weslaco.

2. Image Processing Programs. The following programs have been developed at Weslaco for image processing:

a. Program ERTS-1 - Rapidly displays any ERTS-1 MSS Channel (1-4) from any of the ERTS-1 CCT and overlays a grid that is referenced to the MSS data on the ERTS-1 CCT. (Automatic)

b. Program Quadrilateral - Displays a quadrilateral determined from coordinates taken from grid system of Prog ERTS-1 so that operator can see accuracy of area definition and make further coordinate adjustments if necessary. (Man-Machine interaction)

c. Program Select - Uses quadrilaterals to read data from ERTS-1 CCT of quadrilateral defined areas and records only these areas on a secondary tape for further processing. (Automatic)

d. Program Statistics - Prints out selected area on printer (uses secondary tape) and calculates the following basic statistics for each area and channel: mean, standard deviation, maximum, minimum, range, and distribution (Automatic).

e. Program Preprocess 1 - Combines ERTS-1 channels according to a predefined algorithm and displays the combination. A different subroutine is used to implement any one of the following transformations: addition of channels, ratioing of channels, principal axis transformations, and other (Automatic).

f. Program Preprocess 2 - Corrects ERTS-1 data for variations due to scan angle or scene illumination (Automatic).

3. Pattern Recognition Programs. The following pattern recognition programs have been developed and tested at Weslaco:

a. Program Reformat - Reformats ERTS-1 data in all channels on secondary tape and records on temporary disk file for use with pattern recognition programs. (Automatic)

b. Factor Analysis - Reads data from temporary file and calculates principal axis factor weights that optimally represent most of the variation in the ERTS-1 data. (Automatic)

c. Factor Plot. Generates a scatter plot of the first two principal axes for study of the category data structure. (Automatic)

d. Pattern Recognition - Calculates category standards (mean vector and covariance matrix) and classifies the ERTS-1 data using the maximum likelihood ratio algorithm. (Automatic)

e. Channel Select - Selects optimum channels for pattern recognition using a step wise channel selection procedure. (Automatic)

f. Basic Statistics - Calculates means, standard deviations, correlation matrix, T-values for every category - channel combination. (Automatic)

The sample tapes provided by GSFC have been successfully read by the IBM 1800 computer and displayed on the DICOMED Model 36. Since these tapes were useful only for the formatting information they contained, they were returned to Data User Services with an enclosed receipt acknowledgement. The receipt acknowledgement has never been returned.

In the absence of CCT of ERTS data, we contacted LARS Purdue and MSC Houston and obtained a digital magnetic tape of the microdensitometer readings of a portion of the Imperial Valley from Apollo 9 SO 65 photography. These data have been put into the ERTS-1 CCT format and have proven valuable in testing the above image processing and pattern recognition programs.

We are, therefore, ready and waiting for real ERTS-1 CCT. Two other locations (Chickasha, Oklahoma, Bruce Blanchard, P.I.; Big Spring, Texas, Bill Fryrear, P.I.) have ERTS-1 contracts and are relying on Weslaco for computer assistance with ERTS-1 tapes. When they receive their tapes next reporting period or later they will be assisted.

4. Photoproducts Received.

The photoproducts received through this reporting period are listed in Table 1. In the table the products received are identified by orbit date and number, principal point (PP), size and form; the cloud cover percentage and data quality (qual) listed in the Standard U.S. Catalog are given; and, the date the photoproducts were received is given. Since 9.5" prints were discontinued after the first shipment, and the RBV's corresponding to channels 1, 2, and 3 have not been in use since August 6 these data products are no longer being received.

If we can continue to receive the 70mm negatives and 9.5" positives we will have the photoproducts we need for visual inspection, for printing enlargements, and for producing color composites. A series of enlargements has been made of a few scenes to determine how discernible earth features are as the scale is increased.

A system of manually filing the photoproducts has been developed that enables them to be rapidly retrieved for use. The 9.5" products are trimmed, placed in protective covers, and kept in three-ring binders whereas the 70mm products and glass covers are dried in a dessicator before the images are mounted in the covers and sealed with vapor-resistant tape.

5. Sample Frame and Sample Segment Selection. The assistance of the Statistical Reporting Service was sought in organizing the sample frame and selection of sample segments, since the answer to various questions in the Weslaco ERTS-1 proposal requires a statistical sample of the test county.

Their workers used a 1:90,000 scale photomosaic of Hidalgo County and generalized county highway maps as tools to help select 197 area segments of at least 160-acre size from within the county. The county was divided into three regions: Northern, Central and Southern. The Northern region contains stratum I and IV land, but the Central and Southern regions contain only stratum I land. Stratum I is cultivated land delineated in purple on the frame map. Stratum II (cities) was purposely eliminated from the frame. Hidalgo County contains no Stratum III (marginal land). Stratum IV is defined as range or pasture land and occurs only in the Northern region of the county. The cultivated land in the Southern region is heavy-textured and it is used extensively for winter vegetable production. The cultivated land in the Central region is generally partitioned into small fields, is typically medium-textured terrace soils, and it is devoted to mixed field and vegetable row crop, citrus, and miscellaneous farm enterprises.

The desired sampling unit size in Stratum I was .25 square mile (160 acres) and in Stratum IV, 1.5 square miles. A listing of count units and sampling units by regions was provided on a "County Unit Identification Sheet". Sampling units were accumulated resulting in a total of 3927 which agreed closely with the expected number derived from planimetered acreage of the county. By definition, one sampling unit is one land area segment.

Four interpenetrating samples of size 43 were selected. These were distributed through all three regions. Four more interpenetrating samples were selected, but only the segments located in the Southern region are delineated on the map. The additional 25 segments in the Southern region were put in for use during vegetable surveys.

All eight interpenetrating samples were selected using an "interval and random start" scheme. When a county estimate is generated for interpenetrating samples 1 - 4, the expansion factor for the 43 segments in each sample will be 91.3256. The sum of the four estimates would then be divided by 4 to obtain an estimate for the county. When all eight samples are used, the expansion factor remains the same but regional estimates are required to take advantage of the additional segments in the Southern region. The four estimates obtained for the Northern and Central regions are divided by four and the eight estimates for the Southern region are divided by eight. An estimate for the county is then made by accumulating the regional estimates. The interpenetrating samples enable calculation of sampling errors for the county estimates.

These sample segments constitute approximately 4% of the area of the county. Each field in each segment will be ground-truthed. These fields of known use will be the source of training signatures for pattern recognition signatures.

6. Data Cataloging and Coding. The huge amount of ground truth data necessary for the successful completion of this study, made it mandatory that data be stored, edited and retrieved automatically. All crops, soils and the various descriptive parameters needed to characterize field appearances have been coded. Also, computer card formats have been devised for entry of all data into a computer for editing, and storage on magnetic tape. About 60 different parameters had to be coded. Considerable effort was made to code parameters in such a way that they are easily remembered and read.

7. Field Visits. Before actual field visits could be made the sample segments had to be transferred from the 1:90,000 scale mosaic produced from RB 57F photography, to 1:40,000 scale field sheets of the RB 57F imagery purchased from the ASCS Western Aerial Photography Laboratory at Salt Lake City. This was done to facilitate ease and accuracy of sample segment location in the landscape. Also, during this time period 1:120,000 scale aerial photography was used to make 1:2,000 scale prints of each sample segment.

The ground truth personnel, using the 1:40,000 scale mosaics, located each sample segment and outlined the segment on the 1:2,000 scale prints. Each field in every segment was given a number.

Each time the satellite is due to pass over the test county, each field is visited for ground truth purposes. The percent crop cover, percent weed cover, crop maturity, plant height, plant condition, soil surface condition, plant nutrient deficiency, irrigation and date of irrigation, and other information as well as the date of the visit are recorded for each field. During this reporting period each segment has been visited on four different occasions. Fields are, by definition, plots of land devoted to the same crop or use. The number of fields fluctuates slightly. The total number of fields being ground-truthed each satellite pass is approximately 990.

8. Coding of Data on Computer Cards. After each sample segment has been visited, the field information is coded by the technician in charge of ground truthing and recorded on 80 column computer punch cards. The data on the computer cards is later edited and stored on magnetic tape for use in the analysis of the satellite data. A print-out of these tapes is given to the ground truth personnel. The magnetic tapes and computer cards are stored in separate buildings to minimize the chances of data loss.

9. Acreage Determination. The farmable acreages for some fields were obtained from the county Agricultural Conservation and Stabilization Service office. However, the main thrust in this area will be made in the next reporting period. These actual acreages of fields are needed to provide the acreages involved in the statistical estimates, since total acreage devoted to a given crop is more meaningful than the number of fields. These data will also be used for determining the distribution of field sizes in the county and for comparing the acreage of given classification categories in the training sample by computer and by direct observation.

10. Farmer-Operator Interviews. There are about 600 different farm operators represented in the 197 sample segments. Clearance was obtained from O.M.B. for ground truth personnel to visit with the farm operators and gather the information on farm management and cropping practices outlined on SWC Form 70, May 1972 (sample attached). A letter (also attached) was sent by mail to all farmers before visits began alerting them to the visit and to the type of information desired. Names and addresses were obtained from telephone directory, county ASCS office, and other available sources. At present about 50% of the visits have been completed. This effort will be continued during the next reporting period. These data are being obtained to pin down such information as date of planting, varieties planted, fertilizer treatments applied, whether fields have been land leveled or not, etc. They will help explain spectral differences apparent in the ERTS data but not accounted for by the routine ground truth. They also provide information on yields obtained from crops, intensity of grazing rangeland, and other facts that may be worthy of examination--as for example, whether there are spectral categories within a crop that are relateable to yield or animal carrying capacity. Finally, these data are a rich data source for "fall-out" economic, land use, and farm and ranch practice studies not directly related to the ERTS-1 investigations.

11. Computer Summarization of Ground Truth. Ground truth information is punched on 80 column computer cards. A complete set of data is compiled in an 18 day period centered around an ERTS-1 pass.

A separate card is used for each area from which ground truth is obtained. The information on each card is:

1. Day observation was made
2. Year
3. Stratum from which sample area was chosen
4. Segment number of sample area
5. Field number in segment, permanent division
6. Sector of field for which land use is different, temporary division
7. Day of nearest ERTS-1 pass
8. Land use code
9. Percent of ground cover of primary crop
10. Percent of ground covered by weeds
11. Maturity code of primary crop
12. Height of primary crop
13. Condition code of primary crop
14. Code of any deficiency symptoms in primary crop
15. Code indicating surface condition of exposed soil
16. Code indicating recent irrigation
17. Date of irrigation
18. Leaf area index of primary crop
19. Date fertilizer applied
20. Pounds of N fertilizer applied per acre
21. Pounds of P fertilizer applied per acre
22. Pounds of K fertilizer applied per acre

23. Primary grass in forage areas
24. Percent ground covered by primary forage species
25. Indication that area was being grazed when visited
26. Amount of forage standing
27. Condition code of standing forage
28. Height of primary forage species

Each set of cards is edited by a computer program, EDIT, written for the sole purpose of discovering and noting obvious errors in coding or keypunching the ground truth data. The errors detected by the program are shown in the following list of error messages which are printed when appropriate. The program includes the option of printing all the data along with the error messages or printing only the appropriate error messages.

Error messages printed during editing program:

Error in day
Error in year
Error in segment number
Error in field number
Wrong orbit number
Over 100 percent cover
No cover in crop field
No cover code for weed field
Crop cover given for weed field
Deficiency code given for weed field
No maturity code
No height measurement
No condition code
Negative deficiency code
Date given without indicating irrigation
No date given for irrigation
Invalid irrigation date
Weed cover given for bare soil
Maturity code given for bare soil
Plant height given for bare soil
Plant condition given for bare soil
Nutrient deficiency code given for bare soil
LAI given for bare soil
No soil condition given for bare soil
No debris cover shown
Crop cover given for bare soil

The corrected ground truth data are recorded on magnetic tape with each set of data in a separate file.

Acreage figures for each field are determined from one of three sources. These sources are (1) ASCS records, (2) planimetering a current aerial photograph, or (3) field measurement. These figures must be revised as field boundaries change or as divisions within fields change. These acreage figures are coded to the same segment, field, and sector numbers as the ground truth information. A current listing of acreage figures is kept on a magnetic tape separate from the ground truth information. There are acreage figures for 992 separate areas in the file at the end of this reporting period.

Each set of ground truth information recorded on tape is processed by three specially written programs. Program SEPRT compares 2, 3, or 4 files of ground truth information for each segment, field, and sector listed. In those cases where the land use code is not identical in each file, the program prints the segment, field, and sector number along with the land use code and name for each period being compared. This gives a current listing of land use changes and allows checking for unreasonable or illogical changes in land use. Illogical changes suggest possible errors in coding of land use in one or more ground truth records.

The number of areas and number of sets of data compared in each pass through the program are limited by the memory capacity of our CPU. At present, the program is limited to 1050 areas from three sets of ground truth or to 750 areas from four sets. When the faster 2311 disc units are installed, it will be possible to expand the number of areas and sets that can be included in a single pass through the program.

Program COMB2 combines the ground truth data for a single orbit with the acreage values. The output of this program is a summary of all the land use codes included in the data file. The number of fields, the average crop cover, the average weed cover, and the average height of principal crop along with the number of fields for which acreage figures are available, the total acres, and the average field size are listed for each land use code present. A sample summary is attached.

Program CROP lists all fields for which acreage figures are not included on the acreage tape. The segment, field, and sector numbers have to match exactly to avoid being listed by this program. CROP thus lists those fields which are counted in COMB2 but are not included in the acreage summary. Also listed are fields which have been divided, or combined, differently than when the acreage figures were last updated.

The procedures described above play a very significant role in the total effort on this contract. They enable checks on the manually acquired ground truth for consistency, accuracy, and completeness and they present the ground truth in a form that can be readily used in conjunction with the digital magnetic tapes of ERTS-1 data--for training field selection and for checking the accuracy of the classification assigned these fields by the pattern recognition algorithms.

12. Computer Capability Upgrading. The data quantities involved in a study of this magnitude, the slow speed of the 1810 disc drives, and the fact that the DICOMED display required to do this work was purchased with in-house funds prompted us to request permission from NASA Goddard to upgrade the 1810 disc drive system to a 2311 system from contract funds. Permission to do so was granted. Steps to procure such a system were begun this reporting period. Progress made will be reported subsequently.

Significant Results and Practical Applications:

No significant results can be reported from computer processing because of a lack of ERTS-1 CCT. The ground truthing efforts are producing data that have many uses. For example, the acreage estimates of the fall and winter vegetables sweet peppers, carrots, cabbage, and onions should be more reliable than any previously available to the organizations charged with this responsibility. The statistical estimate of each of these can be calculated as soon as the acres in each field can be determined from photomaps. The field sizes will also permit determination of frequency distributions of various sized fields that occur in the test county and a test of detectability of fields in the ERTS MSS data as a function of size.

Publications:

None.

Recommendations Concerning Changes in Operations, Additional Investigations Efforts, and Effort/Results as Related to the ERTS System:

We recommend that effort be expended by NASA to format the data from the aircraft support flights more like the ERTS data than is presently being done. This would enable investigators to run the same type of analyses on both data sources with maximum ease.

Table 1 shows that we have been furnished photoproducts in a rather inconsistent format. We would like to be consistently and routinely furnished black-and-white 70-mm negatives and 9.5-inch positives. We are disappointed that color composites are not being provided as expected.

There are some scenes we might be able to use a single CCT from. We would appreciate consideration being given to flexibility in ordering, that permits only 1 CCT to be ordered if that is all that is useable.

Changes in Standing Order Forms:

None.

ERTS Image Descriptor Form:

See attached, completed form.

Changes in Retrospective Data Requests:

None.

Table 1.--ERTS photoproducts received during the June 19 to Oct. 19, 1972 reporting period along with identifying, quality, and other information.

File No.	Orbited Area & PP	Cloud Cover	Orbit No.	Orbit Date	HR	Chan	Qual	Material received & Date received			
								70mm Neg	70mm Pos	9.5" Pos	9.5" Pr
								8/25/72	8/25/72	8/25/72	8/25/72
1	CorpChri	50%	27	7/25/72	1002-16332	1	G		x		
2	27.300N					2	G		x		
3	98.132W					3	G		x		
4						4	P	x		x	x
5						5	P	x		x	x
6						7	P	x		x	
7	Weslaco	60%	27	7/25/72	1002-16335	1	G		x		
8	25.855N					2	G		x		
9	98.518W					3	G		x		
10						4	G	x		x	x
11						5	G	x		x	x
12						7	G	x		x	x
									9/11/72	9/11/72	9/11/72
23	Anzul-NW	30%	41	7/26/72	1003-16375	1	G				
13	27.143N					2	G		x		
25	99.269W					3	G				
15						4	G			x	
17						5	G			x	x
19						6	G			x	
21						7	G			x	
								10/18/72	10/6/72		
14	CorpChri	40%	278	8/12/72	1020-16311	4	G	x	x		
16	27.300N					5	G	x	x		
18	97.509W					6	G	x	x		
20						7	G	x	x		
22	LRGV & Mex	40%	278	8/12/72	1020-16314	4	G	x	x		
24	25.891N					5	G	x	x		
26	97.902W					6	G	x	x		
28						7	G	x	x		
								10/6/72	10/6/72		
30	FalDm & So	10%	292	8/13/72	1021-16371	4	G	x	x		
32	26.386N					5	G	x	x		
34	99.204W					6	G	x	x		
36						7	G		x		
								10/19/72		10/19/72	
37	CorpChri	40%	529	8/30/72	1038-16312	4	G	x		x	
38	27.398N					5	G	x		x	
39	97.554W					6	G	x		x	
40						7	G	x		x	
41	LRGV	40%	529	8/30/72	1038-16314	4	G	x		x	
42	25.970N					5	G	x		x	
43	97.952W					6	G	x		x	
44						7	G	x		x	

Sept 17

CODE	NAME	NUMBER OF FIELDS	AVERAGE COVER	AVERAGE WEEDS	AVERAGE HEIGHT	ACREAGE NUMBER	ACREAGE AVERAGE	ACREAGE TOTAL
20	CARROT	1	5.00	0.00	5.00	0	0.00	0.00
30	CABBAGE	5	13.60	11.60	9.60	4	27.39	109.58
50	TOMATO	9	19.22	0.00	21.00	6	42.31	253.90
60	BELL PEPPER	6	20.00	1.16	18.33	3	16.05	48.15
70	CANTALOUPE	1	10.00	0.00	30.00	1	24.80	24.80
90	CUCUMBER	1	50.00	0.00	35.00	1	51.60	51.60
100	TURNIP	1	350.00	0.00	0.00	0	0.00	0.00
140	SQUASH	1	50.00	0.00	30.00	0	0.00	0.00
150	BEAN	2	40.00	0.50	27.50	1	19.50	19.50
390	GENERAL MIXTURE	3	66.66	20.00	51.66	2	15.15	30.30
400	ORANGES	133	45.03	12.05	305.97	94	15.72	1478.51
420	GRAPEFRUIT	108	47.42	9.78	303.27	87	16.80	1461.87
430	TANGERINE	1	30.00	35.00	336.00	0	0.00	0.00
490	MIXED CITRUS	4	31.25	25.50	267.00	3	17.10	51.30
510	COTTON	19	37.63	15.73	57.05	12	21.90	262.89
520	SORGHUM (GRAIN)	58	34.27	39.89	51.91	26	25.52	663.75
529	SORGHUM (FORAGE)	36	53.61	9.38	65.55	20	15.28	305.72
530	SUGAR CANE	6	67.33	12.33	221.83	3	37.93	113.82
540	FIELD CORN	4	23.75	40.00	65.00	2	11.85	23.70
601	AFRICAN STARR	16	88.31	5.31	37.25	8	21.63	173.06
602	COASTAL BERMUDA	25	84.56	8.20	30.48	10	15.94	159.41
604	N K 37	1	90.00	5.00	40.00	0	0.00	0.00
606	BUFFEL GRASS	64	82.04	16.43	48.09	26	61.72	1604.89
605	COMMOM BERMUDA	26	72.88	21.76	27.42	10	10.45	104.58
607	GUINEA GRASS	2	100.00	0.00	80.00	0	0.00	0.00
608	JOHNSON GRASS	1	70.00	30.00	60.00	1	9.90	9.90
611	BLUE PANICUM	1	60.00	25.00	100.00	0	0.00	0.00
619	MIXED GRASSES	4	82.50	17.50	53.75	3	11.86	35.60
621	RHOADES GRASS	2	82.50	17.50	100.00	1	9.50	9.50
622	SILKY BLUESTEM	1	70.00	30.00	60.00	1	21.60	21.60
625	KLEBURG BLUESTEM	2	97.50	15.00	60.00	2	30.58	61.16
630	THREE AWN GRASS	3	21.66	41.66	28.00	0	0.00	0.00
639	MIXED GRASSES	8	80.62	19.37	59.12	3	16.82	50.47
651	MESQUITE	19	59.42	16.84	344.47	13	24.73	321.52
652	RETAMA	1	80.00	80.00	336.00	1	12.00	12.00
653	HUISACHE	3	55.00	40.00	325.33	1	19.30	19.30
658	MIXED SHRUBS	35	46.02	23.14	302.88	5	55.69	278.49
700	WEEDS	196	0.68	54.27	0.00	104	18.47	1921.27
750	NON AGRIC.	34	0.00	0.00	0.00	14	13.02	182.38
900	BARE SOIL	277	0.01	0.01	0.04	181	27.92	5054.85
910	DEBRIS,DRY	124	26.49	0.47	0.40	84	18.32	1538.97
0		21	80.38	22.61	84.04	14	29.74	416.42

Program COMB2 Printout

PLEASE READ NOTES ON BACK OF FORM

FORM APPROVED – OMB NO. 40-R-3811

U.S. DEPARTMENT OF AGRICULTURE – AGRICULTURAL RESEARCH SERVICE
SOIL AND WATER CONSERVATION RESEARCH DIVISION

GROUND TRUTH INFORMATION – INITIAL ☐ FOLLOW-UP ☐

CARD 1

1. DATE (1-6) — Mo. | Day | Yr.

LAND DESCRIPTION

2. STRATUM (7-8)	3. SEGMENT NO. (9-12)	4. FIELD NO. (13-15)	5. PERMISSION OBTAINED TO MAKE OBSERVATIONS AND MEASUREMENTS	6. FARM OPERATOR (Initials)
			YES ☐ NO ☐	

7. SOIL SERIES (16-18)	8. IRRIGATED (19)	9. SUB-SURFACE DRAIN (20)	10. LEVELED (21)
	YES ☐ 1 NO ☐ 2	YES ☐ 1 NO ☐ 2	YES ☐ 1 NO ☐ 2

VEGETATION

11. NAME OF CROP (Cotton, onions, oranges, native or improved pasture, etc.)	CODE (22-23)	12. VARIETY	CODE (24-25)	13. ACRES IN FIELD (26-28)

14. ACRES IN CROP (29-31)	15. ORIENTATION OF FIELD (32)	16. PLANTING PATTERN (33)	17. DATE PLANTED (34-39)
	N-S ☐ 1 NE-SW ☐ 3 E-W ☐ 2 NW-SE ☐ 4	ROW CROP ☐ 1 SOLID PLANTING ☐ 2	Mo. | Day | Yr.

18. FERTILIZER USED FOR THIS CROP (Enter each fertilizer on separate line)

	COMPOSITION A	POUNDS PER ACRE B	DATE APPLIED C	METHOD OF APPLICATION CODE D
1st				
2nd				
3rd				

Enter only one code for each line (40-42)
1 Liquid in bands
2 Liquid in irrigation water
3 Granular in bands
4 Granular in broadcast

19. TOTAL NO. POUNDS (43-51)			20. LAST DATE APPLIED (52-57)			21. FUMIGATION OR HERBICIDE USED ON FIELD (58)
N	P_2O_5	K_2O	Mo.	Day	Yr.	YES ☐ 1 NO ☐ 2 (If yes, complete Item 22)

22. OTHER CHEMICALS USED (Fumigation, herbicide, etc.)

	TYPE OF CHEMICAL USED A	RATE B	DATE APPLIED C	METHOD OF APPLICATION CODE D
1st		per		
2nd		per		

Enter only one code for each line (59-60)
1 Band
2 Broadcast

23. CITRUS DESCRIPTION (If applicable)

	VARIETY A	AGE OF TREES (Yrs.) B	NO. TREES PER ACRE C	NO. TREES IN FIELD D
1st				
2nd				
3rd				

CODED DATA – CITRUS AVERAGES

ITEM	DATA
Age Code	(61)
Number of Trees per Acre	(62-64)
Number of Trees in Field	(65-67)

PASTURE INFORMATION (If applicable)

CARD 2 (1-15) Repeat from Card 1

24. BRUSH CONTROL (16) YES ☐ 1 NO ☐ 2

25. CONTROL METHOD (17)
Land cleared by bulldozer ☐ 1 Root plowed ☐ 4
Chemical applied - airplane ☐ 2 Rolling cutter ☐ 5
Chemical applied - ground ☐ 3 Chained ☐ 6

26. CONTROL DATE (18-23) — Mo. | Day | Yr.

27. LAST RESEEDING (Species)

CODE (24-26)

28. RATE (27-28) LBS. PER ACRE

29. DATE RESEEDED (29-34) — Mo. | Day | Yr.

30. GRAZED BY (35)
COWS ☐ 1 HORSES ☐ 3 WILDLIFE ☐ 5
GOATS ☐ 2 HOGS ☐ 4

31. GRAZING PATTERN (36)
Cont. 12 Mos. ☐ 1 Cont. 3<9 Mos. ☐ 4
Interm. 12 Mos. ☐ 2 Cont. <3 Mos. ☐ 5
Cont. 9 Mos.+ ☐ 3

32. ACRES PER ANIMAL (37-40)

CROP YIELD PER ACRE

33. AVERAGE YIELD OF SAME CROP DURING LAST 5 YEARS (Report lbs.) (41-45)	34. CROP PLANTED IN FIELD LAST SEASON (46-47)	35. YIELD OF CROP PLANTED LAST SEASON (48-52)	36. WAS THE YIELD IN ITEM 35 NORMAL (53)
			YES ☐ 1 NO ☐ 2

SWC FORM 70
MAY 1972

INSTRUCTION FOR THE COMPLETION OF FORM 70

Numbers not listed in the instructions are self-explanatory

Indicate by check whether INITIAL or FOLLOW-UP

1. Date the form is completed.

2. Stratum – A particular section of the study area in which randomized 160-acre sites will be located (a statistical subdivision).

3. Segment – A 160-acre area within a stratum, the term used by S.R.S.

4. Field – A segment subdivision marked by clearly defined boundaries and devoted to a particular crop or land use.

6. Farm operator's initials only, not his signature.

9. Subsurface drain – Underground tile drains or other such devices.

11. Name of crop – A particular plant genus, i.e., cotton, onions, oranges, native or improved pastures.

12. Variety – Refers to a particular plant species – may be a brand name and number, such as "Funk 109", "TPSA", etc. Information will be used only in explanation of possible difference in fields planted to the same crops, i.e., two fields of cotton.

13. Acres in field – Report the total acreage of the field.

14. Report only the number of acres planted to the crop or in the land use identified in item 11. Do not include in the acreage any part of the field not planted to the crop such as ditches, roadsides, bare spots, etc.

15. Orientation of field – The direction the rows run or the direction of the longest dimension of the field.
Code 1: N–S Code 3: NE–SW
Code 2: E–W Code 4: NW–SE

16. Planting pattern –
Code 1: Row Crop – Crops planted on beds with one or more rows of plants per bed.
Code 2: Solid Planting – May be planted by drill or broadcast.

18A. Fertilizer composition – Composition of material, i.e., 16-20-0, 13-13-13, or 0-45-0, etc.

18D. Method of fertilizer application – Code 1: Liquid applied in bands Code 3: Granular applied in bands
Code 2: Liquid applied in irrigation water Code 4: Granular applied broadcast

22D. Method of application – Code 1: Band Code 2: Broadcast

23C. No. of trees per acre – Number of trees planted on an area of one acre (43,560 sq. ft.)

23D. No. of trees in field – Number of trees of a particular variety in the field.

24. Brush control – An operation used to alter or destroy unwanted or unprofitable vegetation; e.g., root plowing, land clearing, spraying with 24D or other chemicals.

25. Control method: Code 1: Land clearing by bulldozer Code 4: Root plowed
Code 2: Chemical applied by airplane Code 5: Rolling cutter
Code 3: Chemical applied by ground equipment Code 6: Chained

26. Date the last control method was applied.

30. Grazed by: Code 1: Cows Code 3: Horses Code 5: Wildlife
Code 2: Goats Code 4: Hogs

31. Grazing pattern: Code 1: Continuously for 12 mos. Code 3: Continuously for 9 mos. or more
Code 2: Intermittently for 12 mos. Code 4: Continuously for 3–9 mos.
Code 5: Continuously for less than 3 mos.

32. Acres per animal – Examples: |1|.|5| |.|7|5| | | |2|
In cow-calf operation, a cow and her calf are counted as one animal.

33. Average yield of same crop – Is defined to mean the average yield per acre during the past five years for the crop growing at the time of the survey. (Example – in past 5 years, cotton was produced 2 years with yields of 1,000 pounds and 500 pounds; therefore, average yield is 750 pounds.)

35. Yield of previous season's crop: Yield of crop planted in this field before the present crop.

36. Normal is defined to mean the yield the farmer expects based on the yields of previous crops.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE

P. O. Box 267
Weslaco, Texas 78596

The first Earth Resources Technology Satellite (ERTS) was launched on July 23, 1972. This is the first of the nation's space programs devoted exclusively to the study of the earth and its resources. The primary objective of this satellite is to determine the amount of information on earth resources that can be gathered by television cameras and multispectral scanners now available for space flights.

USDA, in cooperation with NASA, has chosen Hidalgo County as one of the major sites in which to test the accuracy and reliability of satellite measurements. We plan to evaluate such things as estimates of crop yields, incidence of crop diseases and insects, acreage in certain crops, soil moisture variations, and soil patterns.

To be able to evaluate accurately the results, we must have reliable information on the actual conditions (ground truth). We have chosen at random a number of areas about 160 acres in size to be used for collecting basic ground truth information for evaluation standards. You were identified as operating land in one of the areas chosen.

A USDA official will interview you personally in the near future and ask some questions concerning each field in the sample area. Information includes (1) current crop or land use and previous year's crop yield, (2) planting patterns and dates, (3) fertilizer, herbicides or fumigation used, (4) if citrus is grown, the number and age of trees, and (5) pasture information such as brush control and reseeding. The interviewer will also ask your permission for authorized USDA ground truth personnel to make measurements and observations such as average plant height, percent ground cover, crop vigor, incidence of diseases and/or insects, etc., in your fields. No damage will be done to your crops or fields.

All information is strictly confidential and will be used only to make statistical evaluations on the accuracy of the satellite data.

We would appreciate your cooperation. Please feel free to visit the Research Center at any time to see how the program is progressing.

Sincerely,

DR. CRAIG WIEGAND, Director
Rio Grande Soil & Water Research Center

ERTS IMAGE DESCRIPTOR FORM

PRINCIPAL INVESTIGATOR: Craig L. Wiegand DATE Dec. 1, 1972

USER ID AG 339

AGENCY USDA-ARS

PRODUCT ID (Include Band and Product)	Frequently Used Descriptors *				DESCRIPTORS
	COAST	CROPLAND	RANGELAND	LAKE	
1002-16332-2	X				Cirrocumulus
5	X				Cirrocumulus
1002-16335-2			X	X	Cirrocumulus
5			X	X	Cirrocumulus
1003-16375-2			X	X	Cirrocumulus, Hydrology
5			X	X	Cirrocumulus, Hydrology
1020-16311-5	X				Cumulus +, and Estuary
1020-16314-5	X				Cirrocumulus, Estuary
1021-16371-5			EEO	EEO	
1038-16312-5	EEO	X			Estuary, City, Cumulus
1038-16314-5	EEO				Estuary, Cumulus

*For Descriptors which will occur frequently, write the descriptor terms in these column heading spaces now and use a check (✓) mark in the appropriate ID lines. (For other descriptors, write the term under the DESCRIPTORS column).

MAIL TO ERTS User Services
Code 563
Bldg 23 Room E203 413
NASA GSFC
Greenbelt, Md. 20771